

October 16, 1965

SPECIFICATION

☐ TYPE 880 COMPARATOR
(Rotary and Precision Circle)

Not included

1.0 GENERAL

- 1.1 The ☐ Type 880 Comparator is for precise coordinate and angular measurement on very large sizes of photographic film or plates.
- 1.2 The comparator is to consist of a large mechanical stage and bridge assembly utilizing precision lead screws and lapped ways for motion and guidance of stages. The measuring distances are to be 475 mm in X and 475 mm in Y. A precision rotary table with 360 degrees of rotation is to be provided. Reading dials, a viewing system and light source are to be provided. The instrument is to be supported on a console.

The instrument is to accept 200-foot rolls of 18 in. film or a single 250-foot roll of 9-1/2 in. film. It will measure the full area of 475 mm in "X" by 475 mm in "Y" to one micron. This area of 18.7 in. x 18.7 in. will cover the full format of an 18 in. x 18 in. camera with enough additional to insure full coverage of all fiducials that might lie just outside the 18 in. x 18 in. format.

- 1.3 Design and materials used are to be in accordance with the best engineering practices consistent with precision instrument manufacture.

2.0 SPECIFIC

- 2.1 The comparator base shall be a strong, well-designed casting ribbed to give the greatest advantage of strength and stiffness to weight. The material shall be the Meehanite type of cast iron, specially heat treated to relieve internal stresses before final machining. The three supporting points of this base casting shall also be the feet of the entire instrument and by virtue of this three-point support, the comparator becomes independent of its support console in regard to its effect on final operating accuracy. The main guiding ways of the comparator shall be horizontal on the upper surface of the base casting. The guiding Meehanite ways shall be integral with the base casting and shall be scraped and lapped. The Y stage shall be supported by these ways and shall move along them in a direction to and from the operator, the Y coordinate.

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- 2.2 The Y stage shall be actuated by a precision screw located convenient to the operator's left hand, or if desired, at the wish of the operator, it shall be possible to disengage the stage from the screw and move it freely for quick alignment of widely separated points. The accuracy of this connection between precision nut and stage shall be such that upon repeated engagements the variation does not exceed .001 mm.
- 2.3 The precision lead screw of the Y slide and the X slide shall have a pitch and a lead of one millimeter. The screws shall be precision cut and lapped for accuracy.
- 2.4 The dial system and the manual crank for the Y axis screw shall be located at the end of the screw convenient to the left hand of the operator. The least count dial shall have a direct reading to .001 mm with all graduations upon transparent material. By means of an internally geared counting dial, also on transparent material and the least count dial, the stage position shall be read through a single window. Illuminated and magnified, the dial shall be positioned for proper observation when the operator's posture is that of using the viewing microscope. We believe this system is the easiest and clearest available.
- 2.5 The upper surface of the Y axis stage shall contain the ways for the precision rotary stage. This stage shall rotate upon a circular V-way scraped to such accuracy that the mean center of rotation will not vary more than .002 mm. This precise rotary stage shall be capable of rotation through a full 360° and actuated by reduction gearing suitable for both fast rotation and fine setting for precise alignment. During film reading operations where 200 or 250-foot spools are mounted, it is intended that only enough rotation be used to align fiducial marks parallel to the precision ways.
- The rotating stage shall be equipped with a circle graduated through 360° and read by a vernier to 20 seconds of arc. This reading shall be made by use of an optical system such that the circle setting may be read at any time from the operator's position no matter what the actual position of the Y axis stage in its travel.
- 2.6 The X axis ways shall be supported by upright members rising from side pads of the main base. The arrangement shall be such that a travelling microscope moving along these ways will move in a path parallel to the upper surface of the precision rotary stage and orthogonal to the Y axis ways. This motion

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shall be orthogonal to within 5 seconds. The X axis screw shall be entirely similar to the Y axis screw with respect to pitch, lead, accuracy, travel, and dial system. The stage shall have the same engage-disengage feature.

- 2.7 The manual setting motion shall be accomplished by a hand-wheel that drives the screw, but the handwheel will not be located at the end of the screw. In accordance with human engineering design considerations, it shall be placed at the right front portion of the base. This location is within easy reach and has been found to be the most comfortable for a wide range of operators.
- 2.8 All stages shall be supported upon selected Super-Precision ball bearings, selected by individual tests. The guidance shall be achieved by the use of guidance shoes of a low coefficient of friction material. Contact is maintained by spring loaded rollers on the opposite side of the way. This type of construction shall permit screw loads to be kept at a minimum by reducing greatly the friction of the guiding ways. This design has been found to improve the accuracy of positioning and minimize variations caused by changing loads of film from feed-spool to take-up spool.
- 2.9 Both screws shall be motor driven at maximum speeds of approximately 150 rpm. The motors shall be reversible and shall be connected by electromagnetic clutches that automatically disengage after use leaving the screws free for manual setting.
- Power operation shall be protected by a full system of safety micro-limit switches. Mechanical safety stops shall be provided for manual operation whether stage is engaged or disengaged.
- 2.10 The viewing system shall be a binocular zoom microscope. The binocular system shall be inclined to the stage at a comfortable angle for operator use, but viewing the film vertically from above through a carefully mounted front surface mirror. A zoom feature renders the magnification continuously variable from approximately 20X to 80X with one change of eyepiece. The viewing system has a resolution of approximately 400 line pairs/mm.

The system shall contain one reticle whose pattern shall be a dashed-line, closed-center cross. The reticle line width shall subtend approximately five microns at the film or object plane at all magnifications.

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- 2.11 The illuminator for this binocular viewing system utilizes a tungsten light source located at side of the instrument to reduce heat effects. Proper illumination for the traveling microscope is achieved by a traversing mirror and substage condenser system below the stage. Intensity of the beam may be varied by variable transformer control. The illumination system shall fill the numerical aperture of the viewing microscope objective, providing thereby the maximum attainable resolution of the viewing system.
- 2.12 Substage illumination shall be provided to aid the operator in selection of points to be measured.
- 2.13 The X and Y axis lead screws of the comparator shall be adapted for the mounting of ☐ Type 1045 digitizing heads. This adaptation will not, however, include the digitizing heads. The ☐ Type 1045 digitizing system along with digitizing heads will be quoted on request.
- 2.14 A film stage shall be provided which will accept a 200-foot roll of 18-inch film, 5-3/16 flange diameter. This film stage shall also accept a 250-foot roll of 9-1/2 inch film, 5-15/16 flange diameter. A set of film spool adaptors shall be furnished to accommodate the 9-1/2 inch film spool size.

When using film on spools, only that amount of rotational motion of the stage shall be allowed which will permit the alignment of fiducial marks parallel to the precision way.

The film, during measurement, shall be held between glass pressure plates; a pushbutton and footswitch will be provided for solenoids that relieve this pressure during film transport. A solenoid power supply shall be provided. The film drive shall be manual. The spool support system shall be designed to allow insertion of the film to read any preselected frame without the need of "threading through."

Film spool adapters for other film sizes will be quoted on request.

- 2.15 A specially designed console to support the instrument and a special chair shall be furnished for the operator. Tailored to the comparator design, these accessories compliment the other features of the instrument.

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- 2.16 Incorporating the finest in materials and workmanship, the comparator represents the culmination of years of leadership by the [] in the field of precision screw comparators. It is painted a light, attractive grey with all other finished surfaces treated by protective metal finishes where possible.

3.0 ACCURACY

- 3.1 Exclusive of the quality of the image being read and human error, the overall accuracy of the instrument shall be as follows:

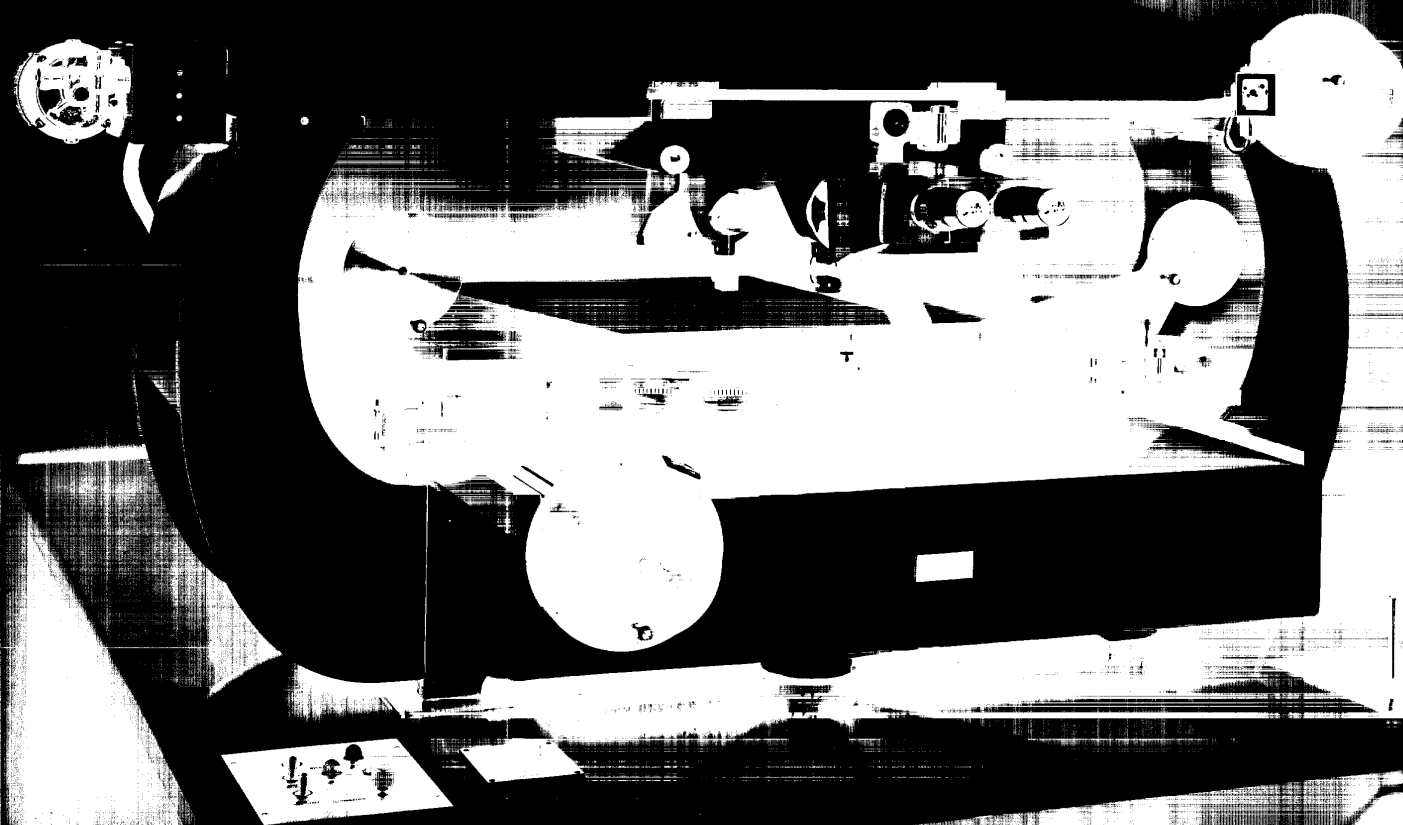
"The actual stage position at any millimeter interval in its travel in the measuring direction shall not deviate from the position indicated by the reading dials by more than .001 mm or .001% of the travel, whichever is greater. The measuring direction of [] Comparators is with the stages traveling toward the dials.

"The rotary stage motion shall be accurate to the nearest 20 seconds of arc.

"The instrument shall be calibrated to be accurate at 68° F."

4 Jan complete "
13 Jan electronics delivered
21 Jan arrive in Wash (PM) ← have all moved during week of
22 Jan installation begin 13th. (Routine service)

Computer plug has to be installed - if not, no final installation accomplished.
Equipment (one or two 880's moved prior to installation)



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